Exhibit 3

➢ Viasat makes WiFi systems including routers.

Mar 25 2018 | Jane Reuter

ViaSat-2 service comes with a powerful wireless router

Advancements in technology enable the Viasat WiFi Gateway to accommodate the higher speeds and faster data flow generated by our ViaSat-2 satellite.

The WiFi Gateway included with our new ViaSat-2 service has a lot in common with its predecessor, but its thoughtful design gives it the power to keep pace with our latest satellite.

Similar to our WiFi Modem, it combines a modem and wireless router that powers your home Wi-Fi network, and is designed to support our VoIP phone service. With advancements in technology made since we designed the WiFi Modem, the Gateway can accommodate the higher speeds and faster data flow generated by our ViaSat-2 satellite.

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Air Force veteran reflects on military career that shaped his life

September 17, 2021

https://www.viasat.com/about/newsroom/blog/viasat-2-service-comes-with-a-powerful-wireless-router/

➢ The Viasat Wifi Gateway is a system that provides WiFi access

Mar 25 2018 | Jane Reuter

ViaSat-2 service comes with a powerful wireless router

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Air Force veteran reflects on military career that shaped his life

September 17, 2021

https://www.viasat.com/about/newsroom/blog/viasat-2-service-comes-with-a-powerful-wireless-router/

- **The Viasat Wifi Gateway provides WiFi access simultaneously to multiple end units that are located throughout rooms in a building**

Inside the WiFi Gateway

As unique as its appearance is, the technology inside the WiFi Gateway is what really sets it apart.

It operates on the latest 802.11 Wi-Fi protocols, standards that ensure networking equipment works with devices created by different vendors. The WiFi Gateway's 802.11ac protocol and antenna design enables the same fast speeds and broad coverage available in the majority of WiFi routers offered by electronics retailers.

The Gateway broadcasts on both 2.4 and 5 gigahertz (GHz) frequency bands. The ability to use both bands means that devices can connect to the frequency band with the best connection, eliminating the need to compromise.

The 2.4 GHz frequency has an extensive range and can more easily pass through obstacles like walls and floors. However, because almost all devices are compatible with this frequency band, the communication channels are narrow, sometimes busy, often are noisy and, as a result, can be slower and less stable at long range. Although it's maximum range is shorter than 2.4, the 5 GHz band is less commonly used and is not as susceptible to other sources of interference, making it a great second option for compatible devices.

https://www.viasat.com/about/newsroom/blog/viasat-2-service-comes-with-a-powerful-wireless-router/

➢ The Viasat Wifi Gateway has video streaming capabilities

A new way of managing video

Much of the new & improved software is contained within the aforementioned satellite, SANs, TRIAs, and WiFi Gateway. But we've also introduced a new way of optimizing video that's at the heart of our unlimited plans. The reason for this is related to a change in how people like to get their entertainment. With the shift toward "cord cutting" — where people tired of paying for cable TV choose instead to stream shows over the internet with services like Netflix — we knew we had to offer a service to accommodate all this streaming.

Video streaming uses a lot of bandwidth, and that ever-growing amount of data consumption can challenge any network. Our solution was to give people the option to stream video at different rates while still offering an unlimited experience. If you primarily watch TV and movies on a phone or tablet, you might be fine with lower resolution streaming at 360p. If you need higher resolution for watching on larger screens, we offer those options as well. The ability to manage all this is made possible by a sophisticated platform that optimizes all of those video streams, allowing more of our customers to watch more video.

https://www.viasat.com/about/newsroom/blog/satellite-innovations/

➢ The Viasat Wifi Gateway supports MU-MIMO and beamforming technologies

Further boosting the WiFi Gateway's performance, it's built with a wireless technology that uses multiple transmitters and receivers to transfer more data at one time. Our device is capable of 3x3 Multi-User, Multiple-Input Multiple-Output (MU-MIMO), which transmits and receives three simultaneous streams on information. That's like using a three-lane highway instead of a one-lane road; with a 3x3 MU-MIMO, your data can get around back-ups and other interference and to its destination more without slowing down.

https://www.viasat.com/about/newsroom/blog/viasat-2-service-comes-with-a-powerful-wireless-router/

- **The Viasat Wifi Gateway supports the latest advanced WiFi standards (802.11ac) for maximum range and elimination of dead zones**

Inside the WiFi Gateway

As unique as its appearance is, the technology inside the WiFi Gateway is what really sets it apart.

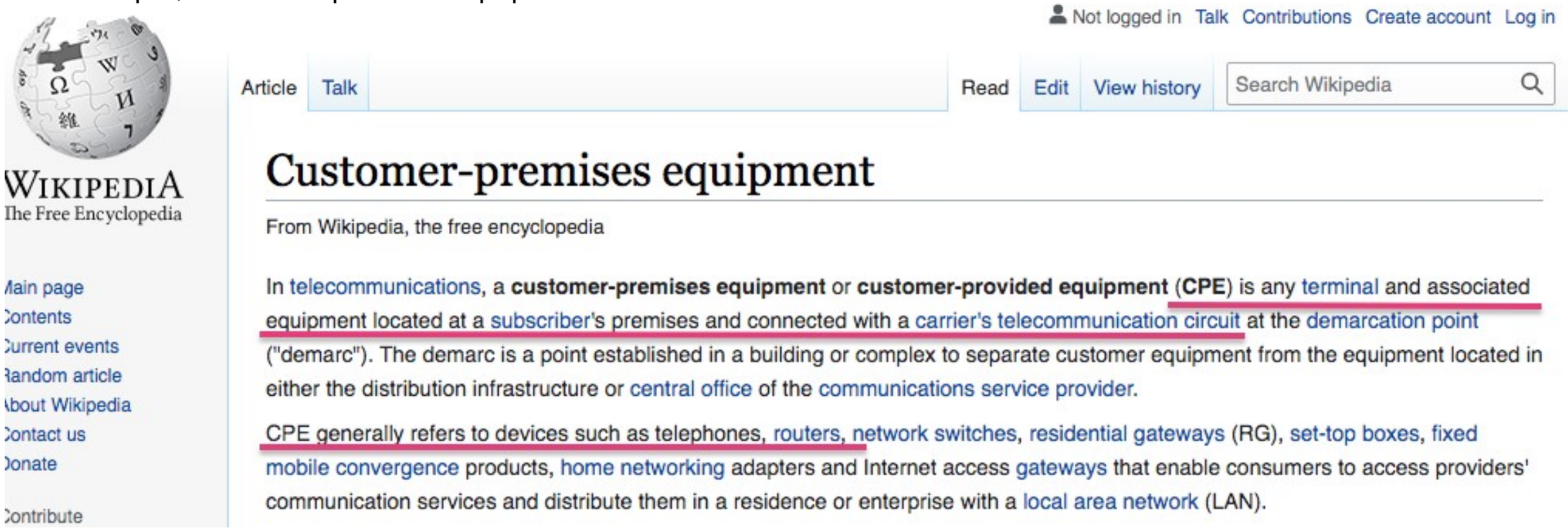
It operates on the latest 802.11 Wi-Fi protocols, standards that ensure networking equipment works with devices created by different vendors. The WiFi Gateway's 802.11ac protocol and antenna design enables the same fast speeds and broad coverage available in the majority of WiFi routers offered by electronics retailers.

The Gateway broadcasts on both 2.4 and 5 gigahertz (GHz) frequency bands. The ability to use both bands means that devices can connect to the frequency band with the best connection, eliminating the need to compromise.

The 2.4 GHz frequency has an extensive range and can more easily pass through obstacles like walls and floors. However, because almost all devices are compatible with this frequency band, the communication channels are narrow, sometimes busy, often are noisy and, as a result, can be slower and less stable at long range. Although it's maximum range is shorter than 2.4, the 5 GHz band is less commonly used and is not as susceptible to other sources of interference, making it a great second option for compatible devices.

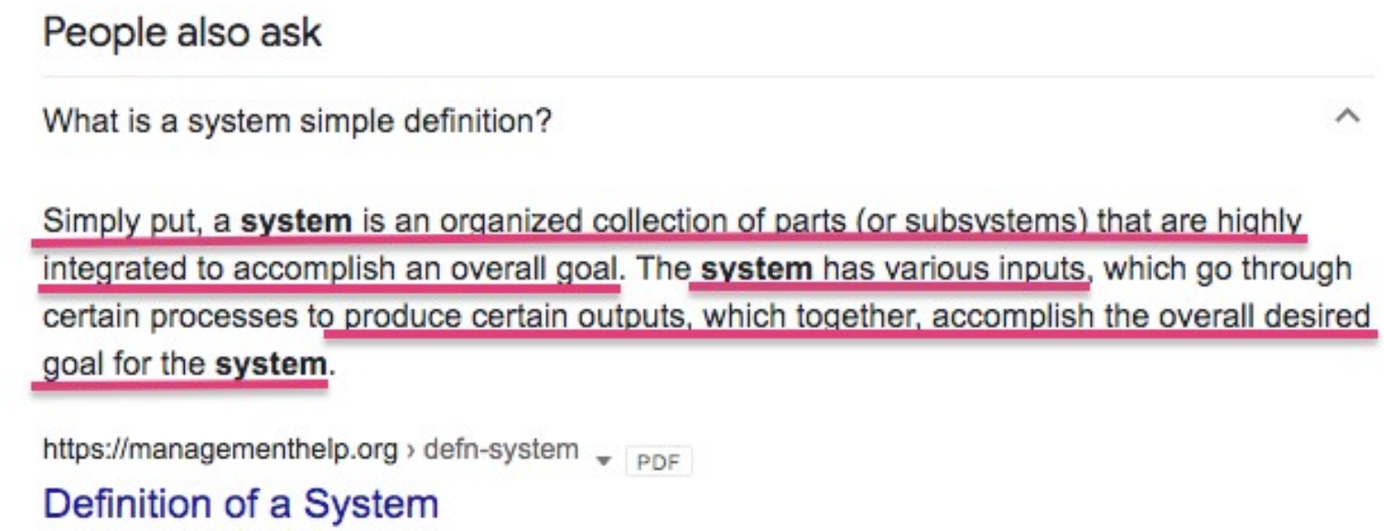
https://www.viasat.com/about/newsroom/blog/viasat-2-service-comes-with-a-powerful-wireless-router/

For example, customer premise equipment includes routers:



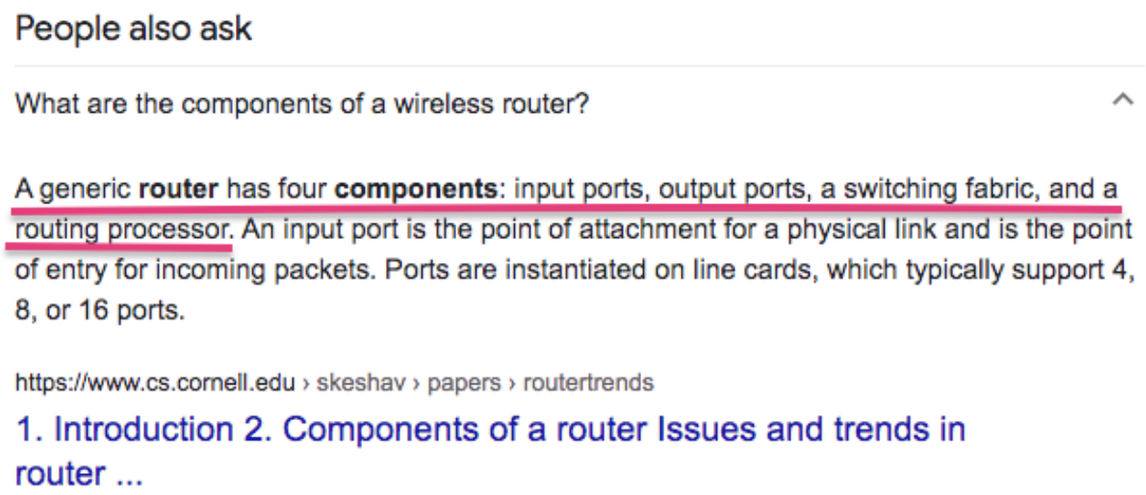
https://en.wikipedia.org/wiki/Customer-premises_equipment

For example, a system is an organized collection of subsystems that are highly integrated to accomplish an overall goal.



https://managementhelp.org/systems/defn-system.pdf

For example, a wireless router is an integrated collection of components (input ports, output ports, switching fabric and a routing processor), which makes it a system. It is used in a home to provide Wi-Fi access. Therefore, a wireless router is a Customer Premise System.



https://www.cs.cornell.edu/skeshav/papers/routertrends.pdf

A **wireless router** connects directly to a modem by a cable. This allows it to receive information from — and transmit information to — the internet. The **router** then creates and communicates with your home **Wi-Fi** network using built-in antennas. As a result, all of the devices on your home network have internet access. Sep. 5, 2019

https://us.norton.com › internetsecurity-iot-smarter-home-...

What is a router, and how does it work? - Norton

https://us.norton.com/internetsecurity-iot-smarter-home-what-is-router.html#:~:text=A%20wireless%20router%20connects%20directly,home%20network%20have%20internet%20access.

According to the patent specification, a customer premise system (also referred to as a wireless distribution system in the patent) does not include end points. For example:

BRIEF SUMMARY OF THE INVENTION

This invention relates to a wireless distribution system for home or business comprising a unitary distribution box, called a wireless multimedia center (WMC), which has inputs for receiving signals from one or more of: a satellite dish; a terrestrial antenna such as a VHF/UHF; a cable line; a telephone or data line such as ISDN, DSL, etc.; and/or fiber optic line, and any other future data or program sources can also be transparently input to the WMC with appropriate modifications or modular plug-ins.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. 1 is a block diagram of a unified multimedia distribution system of the present invention

DETAILED DESCRIPTION OF THE INVENTION

As in FIG. 1, this invention relates to a wireless distribution system for home or business, comprising a unitary distribution box **2**, called a wireless multimedia center (WMC), which has inputs for receiving signals **11**-**14** from one or more of:

a satellite dish **21**;
a terrestrial antenna **22**;
a cable input/output line **23**; and/or
a telephone or data line **24** [ISDN, DSL, etc].

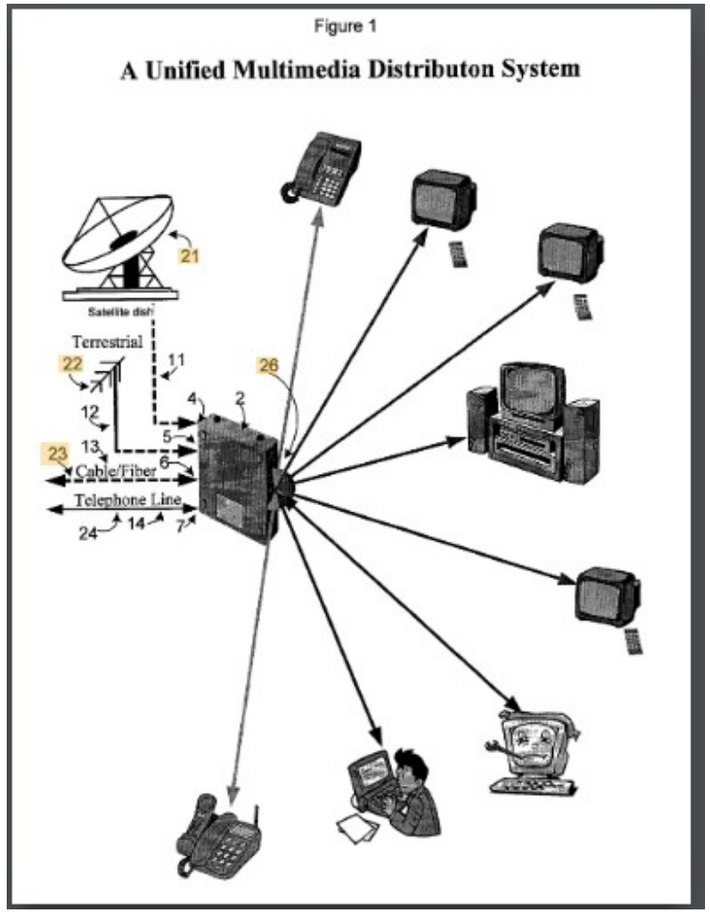


Figure 1
A Unified Multimedia Distributon System
21
Satellite dish
Terrestrial
22
11
26
12
4
2
5
23
13
6
Cable/Fiber
Telephone Line
24
14
7

US7827581 vs. 802.11ac (Wi-Fi) Wireless Routers and Access Points

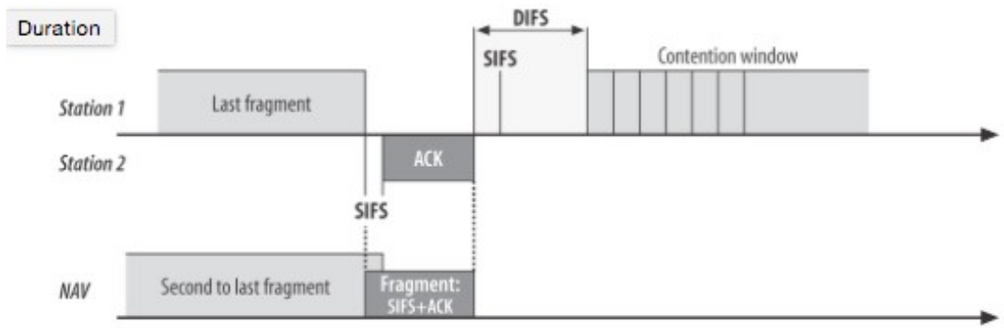
Summary:

These charts compare claims 1, 6 and 28 of US7827581 to 802.11ac compliant wireless routers and access points. Claim 1 is directed to a system for distributing orthogonal frequency division multiplexing (OFDM) signals carrying multimedia information throughout a multi-room building to multiple end units. Dependent claim 6 further limits the system of claim 1 to being a modular system. Claim 28 adds the limitation that the OFDM signal transmissions are spatially directed to the end units. A key aspect of claim 1 is that it requires the system to be able to transmit broadcast traffic (e.g. video streaming) and other traffic (e.g. data communications, voice etc.) separately. This requirement is satisfied by multiple-user (MU) multiple-input multiple-output (MIMO) technology, which enables multiple types of traffic to be carried in the same transmission, via a multi-user data frame. MU-MIMO was first introduced by 802.11ac in 2013. A differentiating feature of claim 28 is that it requires directionality to the transmissions made from the system. The capability was first introduced in 802.11n in 2009, and later improved in 802.11ac. In 2009, IEEE 802.11n introduced MIMO directed beamforming techniques, which supported maximum of four space-time streams per transmission. This feature provided the capability to direct transmissions to one or more diversely located end units. IEEE 802.11ac increases the maximum number of space-time streams to eight.

With a priority date of February 29, 2000, US7827581 predates the standard by 13 years. The standard uses orthogonal frequency division multiplexing as well as multiple-input multiple-output (MIMO) technology both of which compensate for multi-path transmission effects that occur from radio frequency (RF) line of sight (LOS) and RF non-LOS transmission paths, such as occur in multi-room buildings. OFDM technology provides adequate symbol width and guard intervals so as to alleviate inter symbol interference (ISI) effects such as can occur due to multi-path, reflection and absorption phase induced losses. When using broadcast/multicast transmission, 802.11ac routers and access points do not expect acknowledgement (ACK) messages from the end-users devices upon the successful reception of packets.

US7827581 – CLAIM 1	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* {References at end}
1. A customer premises system in which:	The customer premise system is a wireless distribution system for home or business. [1:39-40]	Commentary: IEEE 802.11ac wireless distribution systems include 802.11ac compliant wireless routers and access points. Evidence: "The single-link and multi-station enhancements supported by **802.11ac** enable several new WLAN usage scenarios, such as **simultaneous streaming of HD video to multiple clients throughout the home**, rapid synchronization and backup of large data files, wireless display, large campus/auditorium deployments, and manufacturing floor automation.[6] With the inclusion of USB 3.0 interface, 802.11ac **access points and routers** can use locally attached storage to provide various services that fully utilize their WLAN capacities, such as video streaming, FTP servers, and personal cloud services.[7] With storage locally attached through USB 2.0, filling the bandwidth made available by 802.11ac was not easily accomplished." {1}
the terms: a digital data packet is: a container of data defined by boundaries set according to a protocol;	The definition of a data packet is well known to those skilled in the art of data communications. This is an explicit definition of a digital data packet, which is consistent with the accepted meaning of the term.	Commentary: IEEE 802.11ac is a wireless communication protocol that uses digital data packets, also known as data frames. Three types of data frames are used: data frames, control frames and management frames. Evidence: "Three major frame types exist. ***Data frames*** **are the pack horses of 802.11**, hauling data from station to station. Several different data frame flavors can occur, depending on the network. *Control frames* are used in conjunction with data frames to perform area-clearing operations, channel acquisition and carrier-sensing maintenance functions, and positive acknowledgment of received data. Control and data frames work in conjunction to deliver data reliably from station to station. *Management frames* perform supervisory functions;

US7827581 – CLAIM 1	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* **{References at end}**
		they are used to join and leave wireless networks and move associations from access point to access point." {2}  *Figure 4-1. Generic data frame* {2}
communicate is: to transmit digital data packets bi-directionally, with a hand-shaking mechanism for each digital data packet;	The definition of bi-directional data communication is well known to those skilled in the art of data communications. This is an explicit definition of bi-directional data communication using digital data packets, which is consistent with the accepted meaning of the term. According to this definition, bi-directional communication of digital data packets includes a hand-shaking mechanism for each data packet.	<u>Commentary:</u> IEEE 802.11ac supports bi-directional communication that involves the receiving end unit sending an acknowledgment message to the transmitter of a data frame for data frames that have been successfully received. The graphics shows station 1 transmitting a data frame fragment to station 2, and station 2 responding with an acknowledgement message (ACK). <u>Evidence:</u> "Three major frame types exist. ***Data frames*** are the pack horses of **802.11**, **hauling data from station to station**." {2} "If the More Fragments bit in the Frame Control field is 0, no more fragments remain in the frame. **The final fragment need only reserve the medium for its own ACK**, at which point contention-based access resumes. The Duration field is set to the amount of time required for one short interframe space and the fragment acknowledgment. Figure 4-2 illustrates this process." {2}

US7827581 – CLAIM 1	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* {References at end}
		 *Figure 4-2. Duration setting on final fragment* {2}
broadcast is: to transmit digital data packets in one direction, with no hand-shaking mechanism for each digital data packet;	The definition of broadcasting data packets is well known to those skilled in the art of data communications. This is an explicit definition of broadcasting digital data packets, which is consistent with the accepted meaning of the term. According to this definition, broadcasting digital data packets does not include a hand-shaking mechanism for each data packet.	Commentary: IEEE 802.11ac supports broadcast transmission of data frames, in which case there the receiving end unit does not send an acknowledgement when it receives a data frame. In IEEE 802.11n (2009) the nomenclature for broadcast and multicast frames changed to "group addressed" frames. Generally, group addressed frames are frames that are addressed to more than one destination. The Quality of Service (QoS) control field of a data frame is a 16-bit field that identifies the traffic category or traffic stream to which the frame belongs and other QoS-related information about the frame. The Ack Policy subfield (bits 5 and 6) of the QoS control field is used to specify whether or not the data frame requires an acknowledgement. The combination of bit 5 = 1 and bit 6 = 0 is used for group addressed data frames to indicate that an acknowledgement is not required for the data frame. Evidence: "**Frames transmitted to a broadcast** or multicast destination (Address 1 has the group bit set) have a duration of 0. Such frames are not part of an atomic exchange and **are not**

US7827581 – CLAIM 1	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* {References at end}

acknowledged by receivers, so contention-based access to the medium can begin after the conclusion of a broadcast or multicast data frame." {2}

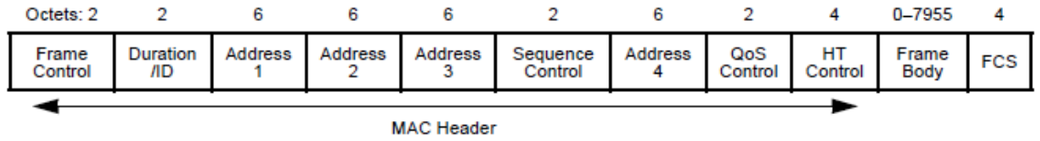


Figure 7-1—MAC frame format

{8}

7.1.3.5 QoS Control field

"The QoS Control field is a 16-bit field that identifies the **traffic category** (TC) or **traffic stream** (TS) to which the frame belongs and various other **QoS-related information** about the frame that varies by frame type and subtype." {8}

7.1.3.5.3 Ack Policy subfield

Table 7-6—Ack Policy subfield in QoS Control field of QoS data frames

Bits in QoS Control field		Meaning
Bit 5	Bit 6	
1	0	No Ack The addressed recipient takes no action upon receipt of the frame. More details are provided in 9.11. The Ack Policy subfield is set to this value in all directed frames in which the sender does not require acknowledgment. This combination is also used for ~~broadcast and multicast~~ group-addressed frames that use the QoS frame format. This combination is not used for QoS data frames with a TID for which a Block Ack agreement exists.

{8}

US7827581 – CLAIM 1	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* **{References at end}**
including: a wireless multimedia center (WMC) for reception on said premises from one or more signal sources and for distribution of segments of signals from said signal sources through the wireless multimedia center	The wireless multimedia center receives signals from various sources such as: a satellite dish, a terrestrial antenna, a DSL or fiber optic line [1:42-48], and transmits segments of the signals to individual transceivers, called end units (EU), located throughout the premises. [1:51-54] The signals are from data or program sources. [1:42-48] Each end unit communicates with the WMC to control which segments the WMC distributes to the end unit. [Abstract]	Commentary: An IEEE 802.11ac compliant wireless router has a Wide Area Network (WAN) port for connecting to a broadband modem. The broadband modem connects to an Internet service provider via a Cable, DSL, fiber optic line, or terrestrial antenna to receive signals carrying data that provides the Internet service. The Internet service provides many different data and program sources from servers connected to the Internet. The wireless router using 802.11ac (Wi-Fi) to communicate wirelessly to multiple Wi-Fi clients simultaneously. The coverage area of a Wi-Fi network can be extended by connected to the wireless router to multiple Access Points (AP) is physically diverse locations. Evidence: "**Router**: This is the **central device of a home network** into which you can plug one end of a network cable. The other end of the cable goes into a networking device that has a network port. If you want to add more network devices to a router, you'll need more cables and more ports on the router. These ports, both on the router and on the end devices, are called Local Area Network (LAN) ports." {3} "Wide-area network (WAN) port: Also known as the internet port. Generally, **a router has just one WAN port**. (Some business routers come with dual WAN ports, so one can use two separate internet services at a time.) On any router, the WAN port will be separated from the LAN ports, and is often distinguished by being a different color. **A WAN port is used to connect to an internet source, such as a broadband modem**." {3} "**Broadband modem: Often called a DSL modem or cable modem**, a broadband modem is a device that **bridges the internet connection from a service provider to a computer or to a router**, making the internet available to consumers." {3} "A wireless network is very similar to a wired network with one big difference: **devices don't use cables to connect to the router and one another**. Instead, **they use radio wireless connections called Wi-Fi** (Wireless Fidelity), which is a friendly name for the **802.11**

US7827581 – CLAIM 1	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* **{References at end}**
		networking standards supported by the Institute of Electrical and Electronics Engineers (IEEE). Wireless networking devices don't need to have ports, just antennas, which sometimes are hidden inside the device itself. In a typical home network, there are generally both wired and wireless devices, and they can all talk to one another. In order **to have a Wi-Fi connection, there needs to be an access point and a Wi-Fi client**." {3} "**Access point**: An access point (AP) is a central device that **broadcasts a Wi-Fi signal for Wi-Fi clients to connect to**. Generally, each wireless network, like those you see popping up on your phone's screen as you walk around a big city, belongs to one access point. You can **buy an AP separately and connect it to a router** or a switch to add Wi-Fi support to a wired network, but generally, you want to **buy a wireless router**, which is a regular router (one WAN port, multiple LAN ports and so on) **with a built-in access point**. Some routers even come with more than one access point (see discussion of dual-band and tri-band routers below)." {3} "**Wi-Fi client**: A Wi-Fi client or WLAN client is a device that can **detect the signal broadcast by an access point**, **connect to it and maintain the connection**. All recent laptops, phones and tablets on the market come with built-in Wi-Fi capability." {3}
to a plurality of end units, in which:	The signals received by the WMC are transmitted to the end units. [1:49-54] There are a wide variety of end units that may receive signals from the WMC. The end units include video end units (VEU), e.g. for TV and radio, and communication end units (CEU), e.g. for telephone and data. [1:54-56] A video end unit may be a set-top box or may be incorporated in a TV. [2:46-48] A communications end	Commentary: An IEEE 802.11ac compliant wireless router or access point is capable of communicating with many types of end units. Examples of the various types of end units, which are 802.11ac compliant Wi-Fi client devices is given in the table below. These Wi-Fi client devices include handheld devices, laptops, tablets, PCs, digital TVs and set-top boxes. Evidence:

<table>
<tr><th>US7827581 – CLAIM 1</th><th>Claim Element Interpretation & Support [patent column: lines]</th><th>Commentary & Evidence
{References at end}</th></tr>
<tr><td></td><td>unit may be separate boxes with various ports such as: serial, parallel, USB, Ethernet, IEEE 1394 or telephone-and/or-fax-and/or-modem. Alternatively, communications end unit PC card may be inserted into a computer. [2:63-67] End units may be adapted to Internet communication terminals, laptop computers, or personal information managers. [3:1-3] An end unit can be universal, analog, digital or both, communications, or any combination. [2:55-56]</td><td>
<table>
<tr><th>Scenario</th><th>Typical client form factor</th><th>PHY link rate</th><th>Aggregate capacity (speed)</th></tr>
<tr><td>One-antenna AP, one-antenna STA, 80 MHz</td><td>Handheld</td><td>433 Mbit/s</td><td>433 Mbit/s</td></tr>
<tr><td>Two-antenna AP, two-antenna STA, 80 MHz</td><td>Tablet, laptop</td><td>867 Mbit/s</td><td>867 Mbit/s</td></tr>
<tr><td>One-antenna AP, one-antenna STA, 160 MHz</td><td>Handheld</td><td>867 Mbit/s</td><td>867 Mbit/s</td></tr>
<tr><td>Three-antenna AP, three-antenna STA, 80 MHz</td><td>Laptop, PC</td><td>1.27 Gbit/s</td><td>1.27 Gbit/s</td></tr>
<tr><td>Two-antenna AP, two-antenna STA, 160 MHz</td><td>Tablet, laptop</td><td>1.69 Gbit/s</td><td>1.69 Gbit/s</td></tr>
<tr><td>Four-antenna AP, four one-antenna STAs, 160 MHz (MU-MIMO)</td><td>Handheld</td><td>867 Mbit/s to each STA</td><td>3.39 Gbit/s</td></tr>
<tr><td>Eight-antenna AP, 160 MHz (MU-MIMO)
. one four-antenna STA
. one two-antenna STA
. two one-antenna STAs</td><td>Digital TV, Set-top Box, Tablet, Laptop, PC, Handheld</td><td>. 3.39 Gbit/s to four-antenna STA
. 1.69 Gbit/s to two-antenna STA
. 867 Mbit/s to each one-antenna STA</td><td>6.77 Gbit/s</td></tr>
<tr><td>Eight-antenna AP, four 2-antenna STAs, 160 MHz (MU-MIMO)</td><td>Digital TV, tablet, laptop, PC</td><td>1.69 Gbit/s to each STA</td><td>6.77 Gbit/s</td></tr>
</table>
{1}
</td></tr>
<tr><td>the signals include video and/or audio signals (hereinafter video) and/or broadband communication data;</td><td>The signals include video or audio signals and broadband data. [5: 17-18] The signals provide distribution of multiple services such as telephone, radio, television, digital data, and Internet throughout the location by wireless digital transmission to end units. [5:11-16]</td><td>Commentary:

The wireless signals transmitted by an 802.11ac compliant wireless router or access point signals for video streaming and broadband data communications.

<u>Evidence:</u>

802.11ac is the latest evolution of Wi-Fi, and it should be particularly good for gaming and HD video streaming. {4}

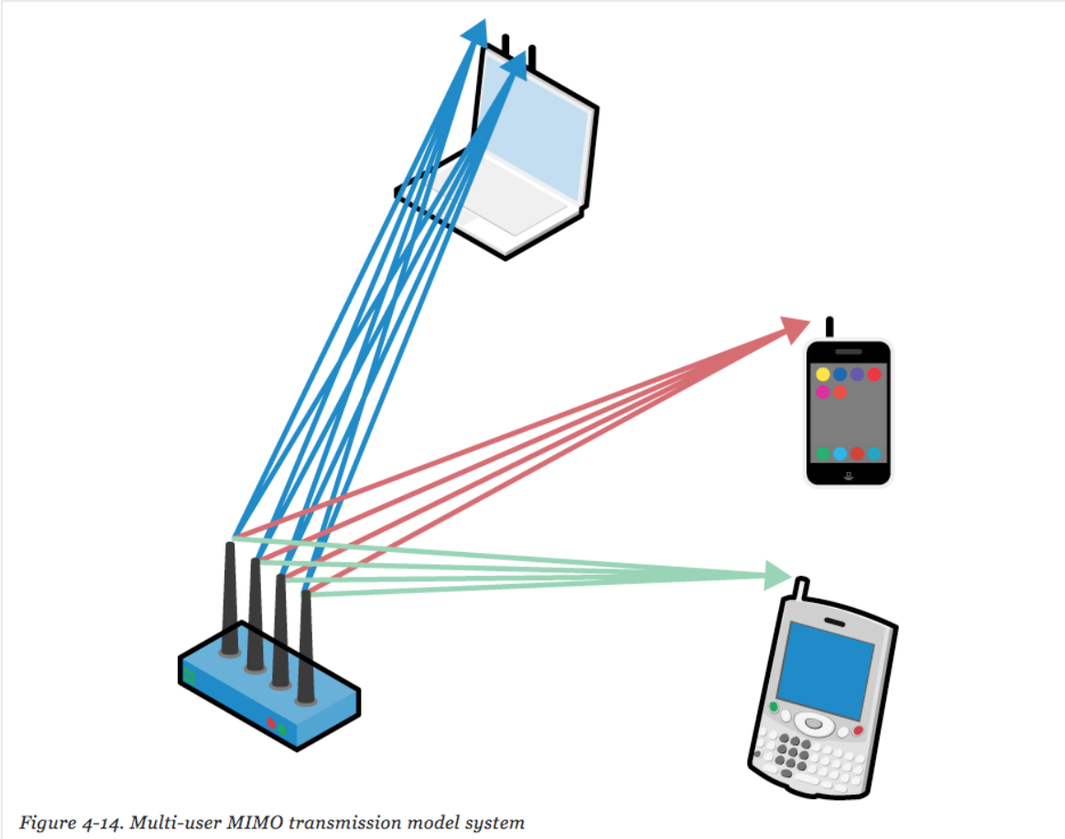
“The single-link and multi-station enhancements supported by 802.11ac enable several new WLAN usage scenarios, such as simultaneous streaming of HD video to multiple clients throughout the home, rapid synchronization and backup of large data files, wireless display, large campus/auditorium deployments, and manufacturing floor automation.” {1}</td></tr>
</table>

US7827581 – CLAIM 1	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* **{References at end}**
		"The last major revision to the main WiFi standard was **802.11ac**, which was designed to dramatically increase the speed of **data transfers**. This is the first standard on the way to "Gigabit WiFi" where speeds can reach 1 Gbit/s, by far the fastest WiFi version to date. 802.11ac also runs solely on the less cluttered 5 GHz band and this higher frequency and modulation rate allows for a higher speed, at the expense of range compared with 2.4 GHz 802.11n or g." {5}
the wireless multimedia center receives all the signals and distributes segments of said signals via a transmitter;	The wireless multimedia center receives all the signals and distributes segments of said signals via a transmitter. [5:19-20] The end units communicate with the wireless multimedia center, controlling which segments of which signals are distributed to each end unit. [Abstract] The data channel instructs the WMC which program and data signals to send to which end unit. Special multiplexing techniques result in extraordinary bandwidth and channel capacity. [1:57-60]	Commentary: An IEEE 802.11ac compliant wireless router is capable of receiving all the WAN signals from a network connection at the premises via a broadband modem. An internal access point in the wireless router and/or an external access point connected to the wireless router transmits segments of the WAN signals as requested by Wi-Fi clients. The wireless router or access point has an 802.11ac compliant transmitter for this purposes and supports multiple user – multiple input multiple output (MU-MIMO) transmission for this purpose. Evidence: Generally, a **router** has just one **WAN port**. {3} **"A WAN** port is used to connect to an **internet source**, such as a **broadband modem**." {3} a **broadband modem** is a device that **bridges the internet connection** from a service provider to a computer or **to a router**, making the internet available to consumers." {3} An access point (AP) is a central device that **broadcasts a Wi-Fi signal for Wi-Fi clients to connect to**. {3} You can buy an AP separately and connect it to a router or a switch to add Wi-Fi support to a wired network, but generally, you want to buy a **wireless router**, which is a regular router (one WAN port, multiple LAN ports and so on) **with a built-in access point**. {3]

US7827581 – CLAIM 1	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* {References at end}
		"Wi-Fi client: A Wi-Fi client or WLAN client is a device that can **detect the signal broadcast by an access point**, **connect to it and maintain the connection**." {3} "With **MU-MIMO**, **multiple simultaneous transmissions** of different Wi-Fi tiers **are sent to multiple devices** at the same time, enabling them to connect at the speed each client needs. In other words, having a MU-MIMO Wi-Fi network is like having multiple wireless routers of different Wi-Fi tiers. Each of these "routers" is dedicated to each tier of devices in the network so that multiple devices can connect at the same time without slowing one another down. "{3}
the video signals are broadcast by orthogonal frequency division multiplexing (OFDM) in which all signals are added together and summed as an orthogonal array having dimensions of time, frequency and amplitude, to transmit spread spectrum multiplexed signals, in which each pulse including said signals has sufficiently long individual pulse widths to defeat multi-path, reflection and absorption phase induced losses;	The video signals are transmitted by orthogonal frequency division multiplexing (OFDM) in which all signals are added together and summed as an orthogonal array having dimensions of time, frequency and amplitude, to transmit spread spectrum multiplexed signals, in which each pulse including said signals has sufficiently long individual pulse widths to defeat multi-path, reflection and absorption phase induced losses. [5:21-28] The video signals are broadcast to one or more end units. [5:39] The OFDM that carries the video signals may be coded orthogonal frequency division multiple access (COFDMA). [5:37-38] The system is capable of using COFDMA as one of the flavors of	Commentary: 802.11ac supports MU-MIMO, which uses space-time coding of the OFDM signals to distinguish the multipath OFDM signals that are destined for the same end unit, and hence are to be combined according to MIMO techniques. The patent contemplated the use of coding OFDM signals. Evidence: "Traditionally, radio engineers treated natural multipath propagation as an impairment to be mitigated. **MIMO** is the first radio technology that treats **multipath propagation** as a phenomenon to be exploited. MIMO multiplies the capacity of a radio link by transmitting multiple signals over multiple, co-located antennas. This is accomplished without the need for additional power or bandwidth. **Space–time codes are employed to ensure that the signals transmitted over the different antennas are orthogonal to each other, making it easier for the receiver to distinguish one from another.** Even when there is line of sight access between two stations, dual antenna polarization may be used to ensure that there is more than one robust path. **OFDM** enables reliable broadband communications by **distributing user data across a number of closely spaced, narrowband subchannels**.[1] This arrangement makes it possible to eliminate the biggest obstacle to reliable broadband communications, intersymbol interference (ISI). ISI occurs when the overlap between consecutive symbols is large

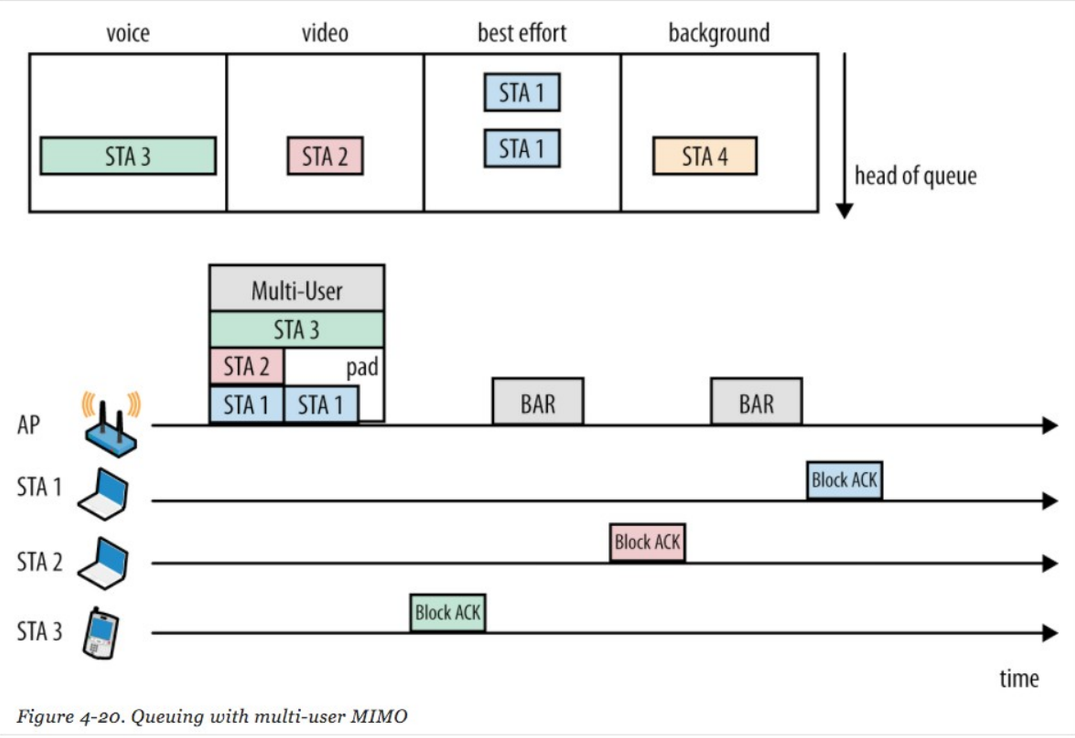
US7827581 – CLAIM 1	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* **{References at end}**
	OFDM. [5:28-29] However, the use of COFDMA is not a requirement of the broadest claims. [5:31-32]	compared to the symbols' duration. Normally, high data rates require shorter duration symbols, increasing the risk of ISI. By dividing a high-rate data stream into numerous low-rate data streams, **OFDM enables longer duration symbols**. A cyclic prefix (CP) may be inserted to create a (time) guard interval that prevents ISI entirely. If the guard interval is longer than the delay spread—the difference in delays experienced by symbols transmitted over the channel—then there will be no overlap between adjacent symbols and consequently no intersymbol interference. Though the CP slightly reduces spectral capacity by consuming a small percentage of the available bandwidth, the elimination of ISI makes it an exceedingly worthwhile tradeoff. "{6}
and: the video signals are broadcast from the wireless multimedia center via one or more separate and dedicated RF channels to one or more end units;	The video signals are broadcast to one or more end units. [5:39] The broadcast streaming media data is received by one or more video end units and the data addressed to the each specific video end unit is extracted by that unit. [5:40-42] The system provides for the transmission of the video/audio, wideband data and communications to multiple end units simultaneously. [5:8-10] Physically separating the end units to avoid crosstalk on the same RF channels is not necessary because each signal is digitally encoded and will be incapable of being read by an end unit not programmed to receive it. [3:61-65]	<u>Commentary:</u> MU-MIMO uses multiple transmit and receive antennas to take advantage of multipath signal propagation to increase communication bandwidth. Space-time coding is applied to the signal transmitted from each antenna so that signals destined to the same end unit can be combined, according to MIMO technology. This creates a separate and dedicated RF channel (by way of the space-time coding) for each end unit, which enables the medium (spectral band designated for Wi-Fi) to be shared simultaneously among multiple end units. This operation is in contrast to 802.11a/b/g in which the medium is shared on a time-multiplexed basis among the end units. The Very High Throughput (VHT) physical specification (PHY) of 802.11ac applies to individually addressed and group addressed transmission (see earlier discussion regarding broadcast/multicast transmissions now referred to as group addressed transmissions). The VHT PHY extends the maximum number of space-time streams supported to eight and provides support for downlink multi-user (MU) transmissions. A downlink MU transmission supports up to four users with up to four space-time streams per user with the total number of space-time streams not exceeding eight. In 2009 IEEE 802.11n introduced four MIMO streams but did not support MU transmissions. <u>Evidence:</u> "When transmitting a multi-user MIMO frame set, 802.11ac handles each individual user separately up to the point at which signals are combined for the analog frontend in the

US7827581 – CLAIM 1	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* {References at end}
		spatial mapper. Figure 4-17 shows a highly simplified block diagram of a two-user MIMO transmission system. Each user's input is treated independently in the digital system, where it is padded and scrambled and has forward error correction applied. **Individual transmissions in a multi-user MIMO system can be coded independently**, so one user may have convolutional coding and a second user may use LDPC. Each transmission is modulated at its own rate, and may or may not have STBC applied. Multiple user transmissions are only combined together in the spatial mapper, at which point the steering matrix derived from the sounding process is applied to the collective data of all users." {7} "**The most important task for a receiver of a multi-user transmission is to determine how to get at its own transmission within the multi-user stream of data while ignoring all the others**. When decoding the transmissions, a receiver can process not only its own stream's VHT-modulated training fields, but also the other streams in the transmission. For obvious reasons, the other streams are called *interfering* streams. **802.11ac places no requirement on a station to decode the interfering data streams**, but doing so will reduce the effects of interference." {7}

US7827581 – CLAIM 1	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* {References at end}
		 *Figure 4-14. Multi-user MIMO transmission model system* {7 } “22. Very High Throughput (VHT) PHY specification

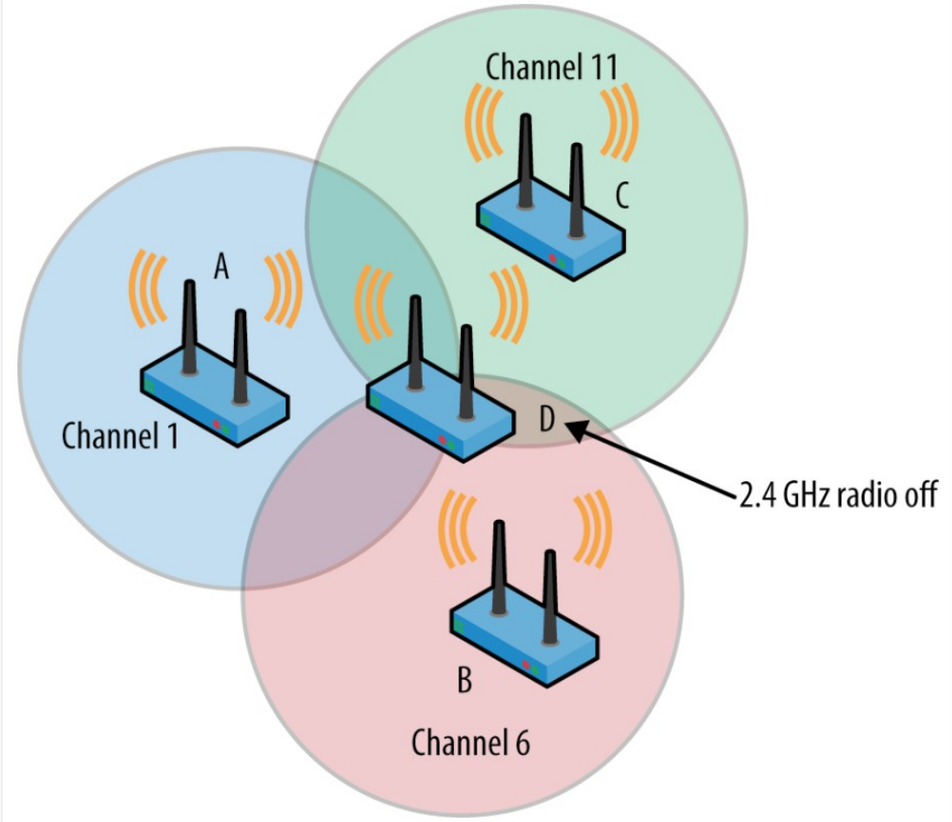
US7827581 – CLAIM 1	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* {References at end}
		22.1 Introduction **22.1.1 Introduction to the VHT PHY** Clause 22 specifies the PHY entity for a very high throughput (VHT) orthogonal frequency division multiplexing (**OFDM**) system. In addition to the requirements in Clause 22, a VHT STA shall be capable of transmitting and receiving PPDUs that are compliant with the mandatory PHY specifications defined in Clause 20. The VHT PHY is based on the HT PHY defined in Clause 20, which in turn is based on the OFDM PHY defined in Clause 18. The VHT PHY extends the maximum number of **space-time streams** supported to eight and provides support for downlink multi-user (MU) transmissions. A downlink MU transmission **supports up to four users with up to four space-time streams per user** with the total number of space-time streams not exceeding eight. NOTE—A VHT SU PPDU includes individually addressed and **group addressed transmissions**." {9}
and optionally, the end units communicate simultaneously with the wireless multimedia center, via a separate bi-directional wideband data pipe (WDP) which provides, as demanded, control for the video channels, data transfer, or plain old telephone service, wherein said wireless multimedia center controls which segments of which signals are distributed to each end unit;	Each end unit communicates with the WMC to control which segments of which signals the WMC distributes to the end unit. [Abstract] The WMC provides data connectivity to all end unit computers via a wideband data pipe (WDP) thereby providing a data network. [4:23-25] Each video end unit informs the WMC which signal the video end unit is to receive, and the wireless multimedia center selects that signal and transmits it to the video end unit. [3:13:17] This enables multiple video end units to be simultaneously receiving streaming digital data from the WMC for as many different	Commentary: An 802.11ac wireless router or access point uses a prioritized queue mechanism to control which segments of signals are included in multi-user frame transmissions. The queue is filled depending on the communication needs of applications that are running on the end unit devices, such as voice, data and video applications. The end units communicate in a bi-directional manner with the router or access point depending on a channel acquisition procedure. The first figure shows an example of a multi-user frame simultaneously carrying voice, video and best effort data packets, which may include group addressed (broadcast/multicast) data packets (e.g. for a video application) and unicast data packets (e.g. for voice and data applications, as well as control of the video, voice and data applications). The second figure shows an example channel assignment for accessing a wideband pipe, which can be a combination one, two, four or eight 20 MHz channels. Evidence: "With MU-MIMO, multiple simultaneous transmissions of different Wi-Fi tiers are sent to

US7827581 – CLAIM 1	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* {References at end}
the video signals are broadcast independently without the presence of communication signals and/or are broadcast simultaneously with the communication signals.	programs as the allocated channels will support. [3:31-34] The signals provide distribution of multiple services such as telephone, radio, television, digital data, and Internet throughout the premises by wireless digital transmission to end units. [5:11-16] Other communication services are provided simultaneously to the broadcast video signals such as fax and telephone or individually tailored on-hold messages, thereby making use the multichannel capability of each end unit. [3:27-30]	multiple devices at the same time, enabling them to connect at the speed each client needs. In other words, having a MU-MIMO Wi-Fi network is like having multiple wireless routers of different Wi-Fi tiers. **Each of these "routers" is dedicated to each tier of devices in the network so that multiple devices can connect at the same time without slowing one another down**." {3} "Multi-user MIMO systems retain the same four queues for **voice, video, best effort, and background traffic** originally developed as part of the 802.11 quality of service architecture." {7} "In this figure, there is a relatively long frame at the head of the voice queue destined for the phone. When the AP gains control of the channel to transmit the voice frame to the phone, the voice access category becomes the primary AC. **The AP begins constructing a multi-user frame, and can now consider other frames and other access categories for transmission**."{7} "For instance, within the transmit queues in the AP it is possible to **select a video frame for one laptop and two best-effort data frames for the other laptop** while retaining the same overall frame transmission time, provided that the two laptop devices are located in directions that are not subject to causing inter-user interference. Even if there are other frames available, such as the background frame shown to the fourth station in Figure 4-20, they may not be included in a multi-user transmission if the receiver is not spatially distinct." {7}

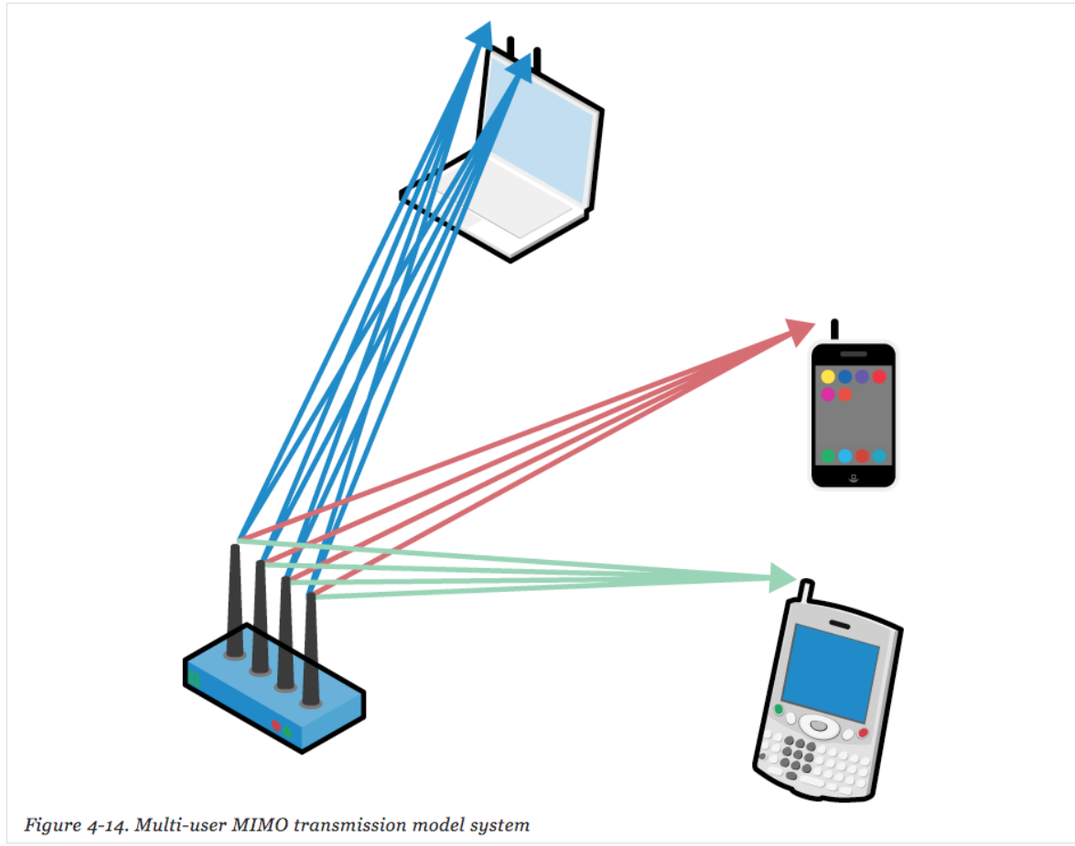
US7827581 – CLAIM 1	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* {References at end}
		 *Figure 4-20. Queuing with multi-user MIMO* {7} "To help with **dividing up airtime between channels, 802.11ac** introduces the terminology of *primary* and *secondary* (or, more formally, *non-primary*) channels. The **primary channel** is the channel used to transmit something at its **native bandwidth**." {7}

US7827581 – CLAIM 1	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* {References at end}
		Table 3-2. Primary and secondary channel relationships in Figure 3-5 **Channel bandwidth** / **Primary channel** / **Secondary channel** / **Total number of 20 MHz channels** 20 MHz / 60 / 64 / One (60) 40 MHz / 60 / 52 / Two (60, 64) 80 MHz / 52 / 36 / Four (52, 56, 60, and 64) 160 MHz / 36 / n/a / Eight (36, 40, 44, 48, 52, 56, 60, and 64) {7 } “A wide channel is made up of a "primary" and "secondary" channel. The "primary" channel is used for 802.11n clients that only support 20MHz channel bandwidth (e.g. legacy clients). For clients that support wide channel capabilities, both primary and secondary channels can be used.” {10}

US7827581 – CLAIM 6	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* **{References at end}**
6. A system according to claim 1 in which the system is modular	A typical customer premise system would have the distribution capability for at least three televisions. However the invention contemplates modular add-ons that will increase this capability as needed. [5:45-48] In an example city block implementation (see Fig. 6), additional wireless multimedia centers or special repeaters may be used to reach the most distant parts of the system. [3:65-67]	Commentary: An IEEE 802.11ac wireless distribution system may an include 802.11ac compliant wireless router connected to multiple access points. The access points may have different primary channel assignments. This facilitates simultaneous service to a much larger number of end units over a larger geographical area as compared to a system with a single wireless router with only one internal access point in it. Evidence: "In a network designed for 802.11ac capacity, generally the APs will be placed where they are needed for 5 GHz coverage. **In a network designed for 802.11ac capacity**, the network will be quite dense because of the high SNR requirements to support the 256-QAM rates (MCS 8 and 9). As a result, there are likely to be places in your network where a dual-radio device does not make sense. Figure 5-1 illustrates one example of this. **Four APs are used to provide high-quality 802.11ac coverage**. However, due to the longer usable range of 2.4 GHz radio signals, even when turning the power down, three APs are sufficient to provide coverage at 2.4 GHz. One of the APs does not need to activate its 2.4 GHz radio." {7} "A common method of adding 802.11ac capacity to an existing network is to **add an 802.11ac radio to a place in space where 5 GHz coverage needs improvement**. Such "infill" APs need only be 5 GHz–capable, but should come from the same vendor as the dual-radio devices already used on your network to ensure that the roaming, band steering, and load-balancing capabilities work with the rest of the network." {7}

US7827581 – CLAIM 6	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* {References at end}
		 *Figure 5-1. 2.4 GHz coverage completeness* {7}

US7827581 – CLAIM 28	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* {References at end}
28. A system according to claim 1 in which the one of the dimensions of the transmission is direction.	The wireless multimedia center is capable of directing a transmission to a specific end unit. An end unit informs the WMC of the signal segment that the end unit is to receive. The WMC then directs a transmission of that signal segment, which is receivable by the end unit, to that end unit. [3:13-17]	Commentary: In 2009, IEEE 802.11n introduced MIMO transmission capability, which supports directed beamforming. Beamforming enables transmissions to be spatially directed to a one or more diversely located receivers. In 2013, IEEE 802.11ac extended the maximum number of space-time streams supported from four streams in 802.11n to eight in 802.11ac. The Very High Throughput (VHT) physical specification (PHY) of 802.11ac applies to individually addressed and group addressed transmission (see the earlier discussion regarding broadcast/multicast transmissions now referred to as group addressed transmissions). The VHT PHY also provides support for downlink multi-user (MU) transmissions. A downlink MU transmission supports up to four users with up to four space-time streams per user with the total number of space-time streams not exceeding eight. The following figure depicts directed space-time streams being transmitted to end units. Note that either the transmission depicted by the blue arrows (i.e. eight streams) or the transmission depicted by the green arrows and the red arrows (i.e. total of eight streams) would occur simultaneously, so as not to exceed the maximum of eight streams. Evidence: **"22. Very High Throughput (VHT) PHY specification** **22.1 Introduction** **22.1.1 Introduction to the VHT PHY** Clause 22 specifies the PHY entity for a very high throughput (VHT) orthogonal frequency division multiplexing (**OFDM**) system. In addition to the requirements in Clause 22, a VHT STA shall be capable of transmitting and receiving PPDUs that are compliant with the mandatory PHY specifications defined in Clause 20. The VHT PHY is based on the HT PHY defined in Clause 20, which in turn is based on the OFDM PHY defined in Clause 18. The VHT PHY extends the maximum number of **space-time streams** supported to eight and provides support for downlink multi-user (MU) transmissions. A downlink MU transmission **supports up to four users with up to four space-time streams per user** with the total number of space-time streams not exceeding eight.

US7827581 – CLAIM 28	*Claim Element Interpretation & Support [patent column: lines]*	*Commentary & Evidence* {References at end}
		NOTE—A VHT SU PPDU includes individually addressed and **group addressed transmissions**." {9}  *Figure 4-14. Multi-user MIMO transmission model system* {7 }

{1} New scenarios and configurations https://en.wikipedia.org/wiki/IEEE_802.11ac

{2} 802.11 Wireless Networks: The Definitive Guide, 2nd Edition, Chapter 4, 802.11 Framing in Detail https://www.safaribooksonline.com/library/view/80211-wireless-networks/0596100523/ch04.html

{3} Home networking: Everything you need to know https://www.cnet.com/how-to/home-networking-explained-part-1-heres-the-url-for-you/

{4} 802.11ac: what you need to know http://www.techradar.com/news/networking/wi-fi/802-11ac-what-you-need-to-know-1059194

{5} WiFi standards explained: what you should know about the new 802.11 ad, ah & af standards http://www.androidauthority.com/wifi-standards-explained-802-11b-g-n-ac-ad-ah-af-666245/

{6} MIMO-OFDM https://en.wikipedia.org/wiki/MIMO-OFDM

{7} 802.11ac A Survival Guide, Chapter 4: Beamforming in 802.11ac http://chimera.labs.oreilly.com/books/1234000001739/ch04.html

{8} IEEE Std 802.11n-2009

{9} IEEE Std 802.11ac-2013

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